NON-PUBLIC?: N
ACCESSION #: 8909210080
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Grand Gulf Nuclear Station - Unit 1 PAGE: 1 OF 6

DOCKET NUMBER: 05000416

TITLE: Reactor Scram Due to Condenser Expansion Joint Failure
EVENT DATE: 08/14/89 LER #: 89-012-00 REPORT DATE: 09/13/89

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Ronald W. Byrd/Licensing Engineer TELEPHONE: (601)437-2182

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SG COMPONENT: EXJ MANUFACTURER: P399
X AA HCU R140
B JM PSV A610
REPORTABLE NPRDS: N
Y
Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 14, 1989, a main condenser expansion joint failed causing condenser vacuum to decrease. The main turbine tripped on condenser low vacuum resulting in a reactor scram due to the fast closure of the main turbine stop and control valves. During the course of the event two subsequent RPS actuations occurred on low reactor water level signals. A Main Steam Isolation Valve (MSIV) isolation signal was actuated on low condenser vacuum. The Reactor Core Isolation Cooling system was manually initiated to control reactor water level. No ECCS were initiated manually or automatically.

All control rods fully inserted with the exception of control rod 32-45 which stopped at position 08. All MSIVs properly closed with the exception of B21-F022B which closed approximately 35 minutes following a manual closure signal. Components in the control rod hydraulic control

unit were replaced to correct the control rod malfunction. The failure mechanism of the MSIV was determined to be generic to other installed MSIVs and is reported separately in LER 89-013. A 3 foot section of the condenser expansion belt had torn horizontally near the lower retaining clamps. The hemp reinforcement fibers had apparently degraded due to moisture intrusion through the rubber. The belts on all three condenser sections were replaced with belts utilizing a polyester reinforcement fiber which is less susceptible to degradation from moisture exposure.

PCOM LER 89-012-00

END OF ABSTRACT

A. Reportable Occurrence:

On August 14, 1989, a main condenser (EIIS system code: SG) expansion joint failed causing condenser vacuum to decrease. The main turbine tripped on condenser low vacuum resulting in a reactor scram due to the fast closure of the main turbine stop and control valves. During the course of the event two subsequent RPS actuations occurred on low reactor water level. Additionally the Main Steam Isolation Valves (MSIVs) received an isolation signal on low condenser vacuum. The MSIV isolation is an ESF actuation. The RPS and ESF actuations are reported pursuant to 10CFR50.73(a)(2)(iv).

B. Initial Conditions:

The plant was operating at approximately 100 percent power prior to the event.

C. Description of Occurrence:

At 0818 on August 14, 1989, a condenser expansion joint seal low water level alarm annunciated in the control room which is indicative of a breach in the condenser expansion joint. Simultaneously condenser vacuum began to drop. An immediate power reduction via reactor recirculation flow control (EIIS system code: AD) was directed by the Shift Superintendent. An operator was dispatched to the local control panel to check the automatic operation of the expansion joint water seal level control valve. At 0820, with the reactor reduced to approximately 80 percent power, the main turbine (EIIS system code: TA) tripped due to a condenser low vacuum of approximately 22 inches of mercury. The reactor

scrammed on a fast closure of the main turbine stop and control valves. Both reactor recirculation pumps tripped from fast speed to slow speed due to a valid End-of-Cycle Recirculation Pump Trip (EOC-RPT) signal. All rods inserted with the exception of control rod 32-45 which stopped at position 08. The control rod was later inserted full-in to position 00.

Reactor pressure increased following the scram to the ATWS ARI/RPT trip setpoint causing both recirculations pumps to trip off. The peak pressure for the transient was approximately 1100 psig. Two channels of the safety relief valve (SRV) low-low set logic actuated but these two channels do not complete the actuation logic; therefore, no SRVs lifted. This is acceptable since the Technical Specification lowest lift setting for any SRV is 1103 + /-15 psig. The turbine bypass valves quickly reduced reactor pressure to approximately 950 psig.

Approximately 20 seconds following the scram, the "B" Reactor Feed Pump Turbine (RFPT) was secured to avoid a high reactor water level trip (Level 8 Trip at +53.5 inches). The "B" condensate and condensate booster pumps (EIIS system code: SD) were secured by operators at 0824. However, the level 8 setting was reached at 0830 which tripped the operating "A" RFPT (EIIS system code: SJ).

Condenser vacuum continued to decrease. The turbine bypass valves were used to reduce pressure to approximately 575 psig. The resulting shrink in reactor water level caused an RPS actuation on low water level (Level 3 Trip at + 11.4 inches). At 0840 the reactor scram was reset and the Reactor Core Isolation Cooling (RCIC) system was initiated to increase level.

Operators anticipated that the Main Steam Isolation Valves (MSIVs) would isolate as condenser vacuum decreased. Preparations were made to close the MSIVs and control reactor pressure with the SRVs. By 0915 the inboard and outboard MSIVs were manually closed prior to condenser vacuum reaching the low vacuum trip setpoint. However, one inboard MSIV, B21-F022B, failed to close. This valve also did not close after the low vacuum MSIV closure setpoint was reached. The isolation of the MSIVs on low condenser vacuum is considered an ESF actuation. This valve did close without any operator actions approximately 35 minutes following the initial closure attempt.

Following the closure of the MSIVs, reactor pressure control was maintained using the SRVs. Five separate single SRV actuations were made for pressure control. After the third SRV actuation, the resulting shrink in reactor water level caused a second reactor scram at 0945 on Level 3. This scram was not reset until 1022 after the final SRV actuation, and no further RPS actuations occurred.

The plant proceeded to cold shutdown for investigations and corrective maintenance. Cold shutdown was attained at 2029 on August 14, 1989.

D. Anomalies Noted During the Event Response:

1. Immediately following the scram, The Nuclear Steam Supply System (NSSS) computer printed a message indicating that one control rod was not full-in. After printing the message, the computer locked up and the STA was unable to obtain a rod position scan. The STA and other control room personnel observed control rod positions on the P680 panel full core display and believed that all rods were inserted. However, rod 32-45 was at position 08 rather than 00. The rod position was identified when the NSSS computer was restored at 0929 and a control rod scan was performed which identified control rod 32-45 to be at position 08. The rod was then inserted to position 00.

2. The failure of MSIV B21-F022B was determined to be due to a malfunction of the ASCO solenoid valve that controls the air supply to the MSIV actuator. A fragment of the solenoid valve seat seal material had broken apart and became lodged in the solenoid exhaust port such that venting air from the actuator was impeded. This condition has been determined to be generic to other installed MSIVs at GGNS and is being reported separately in LER 89-013.

3. The scram discharge volume (SDV) vent & drain valves were observed in the closed position by reactor operators following the initial scram. However, one of the two vent valves and one of the two drain valves failed to re-open when the scram was reset. The two vent valves and the two drain valves are installed in series. Thus, the vent path and drain path were isolated which prevented the scram discharge volume from being

drained. The vent & drain valves also failed to re-open after the two subsequent low water level scrams were reset. An investigation revealed that the air throttle valve which controls the stroke time for both valves was closed. The required position of the valve is one-eighth turn open. After the air throttle valve was repositioned, the vent and drain valves properly opened to drain the scram discharge volume.

4. The trip of the recirculation pumps due to the ATWS ARI/RPT actuation caused reduced core flow and some degree of stagnation in the bottom head area of the reactor vessel. Cooler control rod drive flow as a result of the scrams and the reduced mixing in the bottom head area caused the bottom head drain temperature to exceed the Technical Specification cooldown limit of 100 degrees F per hour. The cooldown rate at the bottom head drain was exceeded twice. From 0818 to 0900 the temperature decreased 149 degrees F, and then rose slightly. From 0930 to 1030 the temperature decreased 111 degrees F.

The Technical Specification heatup rate limit of 100 degrees F per hour was also exceeded at the bottom head drain during recovery. The heatup rate was exceeded by a temperature rise of 123 degrees F from 1116 to 1216. When condenser vacuum was reestablished with the mechanical vacuum pumps and the main steam line drains were opened, the increased reactor steam flow aided in coolant mixing in the bottom head area and the increase in the bottom head drain pipe temperature.

At all times during the event the temperature readings at the reactor vessel head flange, bottom head, and shell flange all indicated cooldown and heatup rates within the 100 degrees F per hour limit.

E. Apparent Cause/Corrective Actions:

1. The loss of condenser vacuum occurred when a 3 foot section of the high pressure condenser expansion belt ruptured horizontally near the lower retaining clamps. An inspection of the failed section of the expansion belt revealed that it could be torn by hand. The hemp reinforcement fibers had apparently degraded due to moisture intrusion through the rubber.

The belt had been installed as original equipment. Periodic inspections and hardness tests were conducted but did not reveal any significant degradation of the rubber.

The expansion belts on all 3 condenser sections were replaced with belts containing a polyester reinforcement fiber that is less susceptible to degradation from moisture exposure. System Energy is presently conducting an assessment of industry experience with condenser expansion belts. This data will be used to institute a fixed replacement cycle or to establish more comprehensive tests and inspections that better assess the aging condition of the belts. Resolution to preclude recurrence will be completed by the fourth refueling outage (RF04).

2. Control rod 32-45 was stroked, timed, and friction tested with no abnormal results. The control rod was also tested by withdrawing it fully to position 48 and generating a scram signal. During this test, the control rod stopped at position 32.

It was concluded that the malfunction existed in the Hydraulic Control Unit (HCU). The scram pilot valve, the scram valve diaphragms, the seats of the scram valve, and the accumulator cylinder were all replaced and examined. There was no specific component failure mechanism identified that would have caused the control rod to not fully insert. Following this rebuild, the control rod operated properly. The rod was successfully scram tested again during plant restart on August 23, 1989.

3. The failure to immediately recognize the control rod at position 08 was due to personnel error by the Shift Technical Advisor (STA) and licensed operators. Several factors may have contributed to the delay in determining that one rod was not full-in. The "00"s being-displayed for the other 192 control rods reduced the visibility of the one rod position display of "08". This factor combined with the known historic reliability of the RPS, the NSSS computer failure, and the demand to be attentive and responsive to other events, all contributed to the oversight. CRT monitoring and backup alarm messages for the rod position were unavailable until the NSSS computer was restored. When the NSSS computer was restored it was readily determined by a rod position scan that control rod 32-45 was not full-in.

A memorandum was distributed to each licensed operator and STA to explain the events and causes of the delay and to emphasize the need for extra diligence when checking the full core display following a scram. A standing order was issued requiring control rod 32-45 to be specifically verified full-in following future scrams.

4. The MSIV failure was determined to be due to a condition that is generic to the other installed MSIVs and is reported separately as LER 89-013.

5. The cause of the closed air throttle valve to the SDV vent and drain valve was not determined. The throttle valve is near a deck plate where it may have been inadvertently bumped closed. To preclude recurrence, both air throttle valves have been lockwired in the require position so that air flow to both vent valves and both drain valves will be maintained. An identifying label was placed near the valve marking the valve as "critical" and providing a caution about repositioning.

6. As stated in section D above, the primary cause of exceeding the bottom head drain cooldown and heatup rates was due to the reduced coolant mixing in the reactor vessel bottom head area as a result of the trip of both reactor recirculation pumps.

Technical Specification 3.4.6.1 requires an engineering evaluation to be performed to determine the effects of the out-of-limit condition on the structural integrity of the reactor coolant system. An evaluation of the bottom head region of the reactor vessel, the drain piping, and critical penetrations concluded that the impact of the heatup and cooldown rates were insignificant when compared to the design usage factor and that there were no structural integrity concerns associated with continued operations.

Off-normal Event procedures appropriate for this type of transient will be revised to emphasize the bottom head drain temperature effects of having no recirculation pumps operating. The procedure change will also emphasize establishing reactor coolant recirculation as soon as possible. The procedure change will be completed by September 30, 1989.

7. The cause of the NSSS computer lock-up could not be determined. The scram logging function was tested by withdrawing control rod 32-45 full-out to position 48 and simulating a reactor scram input to the NSSS computer. The test determined that the scram logging function of the computer was performing properly. In addition, complete diagnostics were performed and no problems were identified. All internal power supplies were checked and found to be within specifications. Similar lock-ups unrelated to scrams have occurred previously but are considered generally infrequent.

F. Safety Assessment:

Reactor water level was maintained at least 166.7 inches above the top of active fuel. The reactor water level 2 setpoint of -41.6 inches was not reached and therefore no ECCS initiation occurred. All safety systems responded as designed with the exception of control rod 32-45,and MSIV B21-F022B. The reactor was subcritical following the scram and would have continued to remain subcritical with control rod 32-45 not fully inserted. The containment penetration at main steam line B was isolated by the closure of the outboard MSIV, B21-F028B.

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ATTACHMENT 1 TO 8909210080 PAGE 1 OF 1

SYSTEMS ENERGY
RESOURCES, INC.
A Middle South Utilities Company

WILLIAM T. COTTLE
Vice President
Nuclear Operations

September 13, 1989

U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

Attention: Document Control Desk

Gentlemen:

SUBJECT: Grand Gulf Nuclear Station

Unit 1
Docket No. 50-416
License No. NPF-29
Reactor Scram Due to Condenser
Joint Failure
LER 89-012-00
AECM-89/0173

Attached is Licensee Event Report (LER) 89-012-00 which is a final report.

Yours truly,

WTC:cg
Attachment

cc: Mr. D. C. Hintz (w/a)
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